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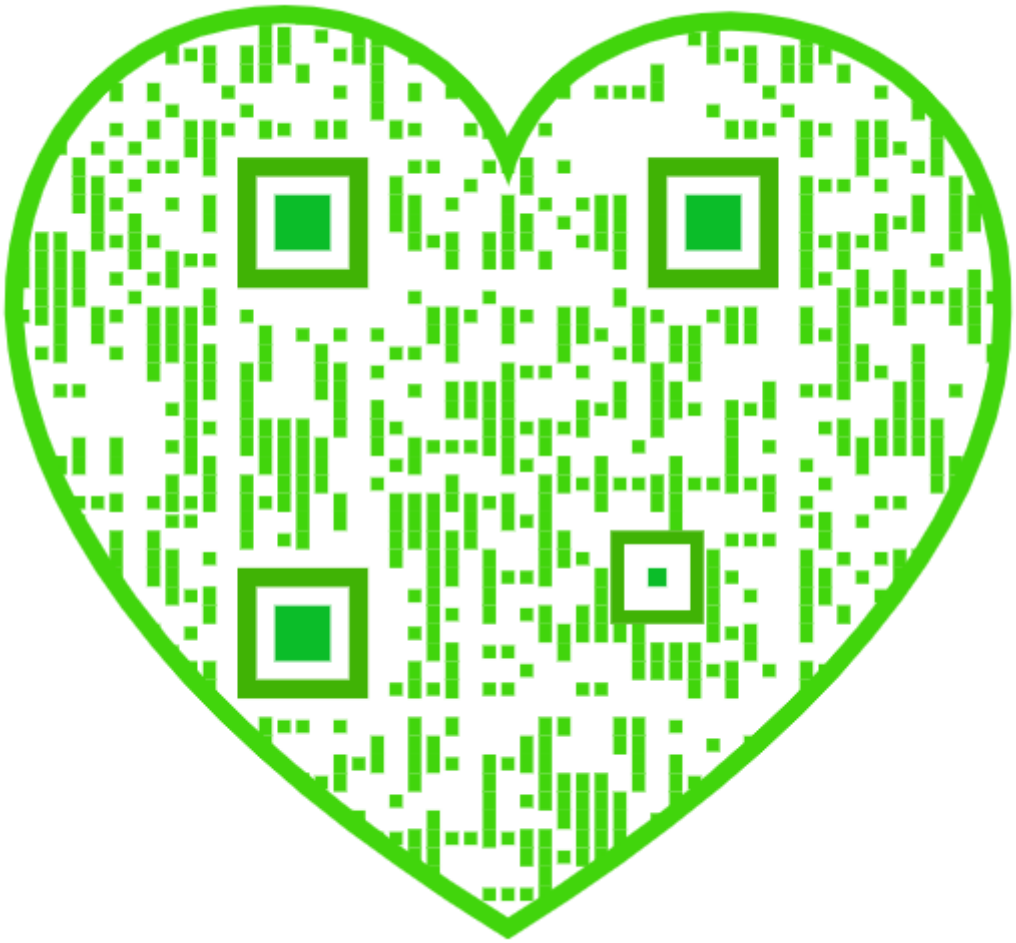

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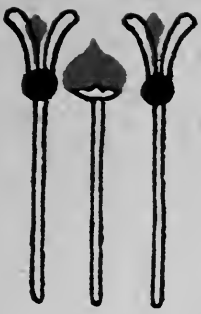

The Art of Making Paper

(Pa-þ-yor)

Title

Rensselaer W. Daniels, B.A.

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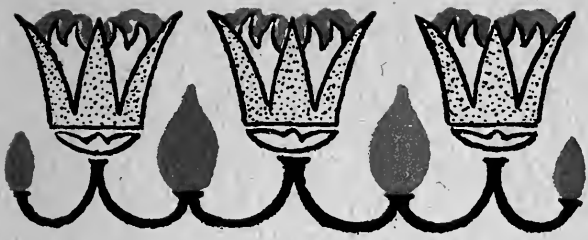
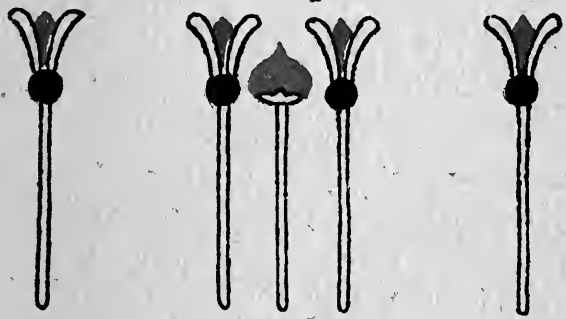


HERE FOLLOWS

a series of mono-
graphs on the mak-
ing of paper in
the early days,

by Rensselaer
W. Daniels, B.A.



The First of the Series

Most curious it is, that though the name of paper has its origin with the Egyptians, the commodity itself, as we know it and as it has been known to civilization for centuries, has no genetic connection with the papyrus roll of antiquity. As in the case of many useful arts, the earliest beginnings of paper-making, properly so-called, must be traced among the Chinese; but it is worth while to bestow some attention upon a material which anticipated both the name and function of paper.

OF MAKING PAPER

Papyrus is the classical form representing the name of an aquatic plant called by the Egyptians pa-p-yor, signifying "the thing or product of the river." From the Latin the term has found its way with slight variations into most of the languages of Europe. The plant was grown in great abundance in the marshes of the delta and in the pools formed by the overflow of the Nile. It is believed, however, not to have been indigenous to the country, as it is not found in modern Egypt. If this was the case, the Egyptians probably introduced it from Nubia or Abyssinia, where it still grows wild. It had a large root and a smooth, thick, triangular stalk rising several feet above the water and bearing at the top a beautiful plume which had its uses in decorating the statues of the gods. In fact, every part of the papyrus plant was utilized, so that an astonishing variety of articles was evolved from this simple reed. The discovery of its value as a writing material must date from remote antiquity and the process of fabrication probably varied but slightly during thousands of years.

Pliny the Elder, a Roman writer of

the first century of our era, gives the fullest account that has come down to us of the process of manufacturing the papyrus sheet. Unfortunately, owing either to the corruptions of the text or to Pliny's own imperfect acquaintance with the subject, his narrative is in some parts obscure. The general features, nevertheless, may be readily grasped. It seems to be well established now that the raw material was the pith of the plant and not the bast or thin membranes as formerly was assumed, investigation having shown that the papyrus, like other reeds, contains within the rind only a cellular pith. This pith was split into thin strips with some sharp instrument, Pliny says with a needle; but this could hardly have been the case. At any rate, however done, this primary work demanded the greatest care and skill, for no subsequent treatment could wholly remedy a fault committed at this stage. The strips thus obtained were laid side by side on a table, their edges slightly overlapping and secured to each other by some adhesive preparation, of which Nile water was an essential, or, at least, a favorite ingredient. The ends were

fashioned and cut off evenly. The width of the strips would depend, of course, upon the size of the stalk, and the width of the sheet could be made as desired. Over this sheet as described was now laid a second formed in the same manner, but with the strips crossing the first at right angles. The whole was then subjected to heavy pressure, dried in the sun, and finally smoothed with a piece of ivory or shell. The papyrus roll was formed by gluing these sheets together end to end, never more than twenty sheets to the roll, according to Pliny. In the last particular he is in some error, as rolls are extant exceeding this limit. Probably the practice varied at different epochs.

Defects in the sheet were either remedied or concealed by the use of a sizing made from wheat flour mixed with boiling water and a few drops of vinegar added. But sizing was also used merely to give a fine finish to the surface and for the highest class of work was made by straining the water in which crumbs of leavened bread had been boiled.

Some eight or nine varieties of papyrus are enumerated, each bearing a dis-

tinctive name by which it was known to the trade. It must be borne in mind that the nomenclature given belongs to the Graeco-Roman period, but corresponding no doubt measurably with the earlier Egyptian practice.

The finest quality was known as the Augustan, so termed in honor of the Emperor Augustus; while the next grade bore the name of his wife, Livia. Another kind was the Amphitheatrica, an inferior quality extensively manufactured near the Amphitheater of Alexandria, and which Remmius Fannius made over at his factory in Rome into a first-class article to which he gave his own name, the Fannian. Cheaper varieties still were the Saitic and Taeniotic, the latter sold by weight only, while the Emporetic, that is, "shop-paper," used only as a wrapping material, stood at the foot of the list.

The width, which in the Augustan was not far from twelve inches, narrowed down through the scale to three and one-half inches in the Emporetic, which must consequently have been wound around packets like a ribbon. An improvement on the Augustan brand was introduced under the Emperor

Claudius and hence called the Claudian. It consisted in backing the Augustan with a coarser sheet to give it body and obviate transparency.

From the papyrus pith the Egyptians had succeeded in fabricating an almost perfect writing material, light, smooth, strong, of convenient size and great durability. Indeed, in the last respect, nothing was left to be desired. The earliest extant specimen of papyrus dates from the thirty-sixth century B. C. That means that when Israel went out of Egypt this bit of papyrus was as old even then as all the years that have passed since our era began.

Down to the time of Alexander's conquest the papyrus industry was a government monopoly, and the sale of the product was strictly regulated. As it was a common practice in Egypt to wash the writing off and use the papyrus over and over, we may fairly infer that in those times the material was sold at a considerable price. When under Alexander's successors all restrictions were removed the trade developed prodigiously and papyrus became one of the chief articles of Egyptian export. The multiplication of factories and ware-

houses kept pace with the increased demand. At one time in Rome serious popular disturbances arose owing to the scarcity of papyrus following the failure of the Egyptian reed crop. This circumstance indicates clearly the staple character that the commodity had assumed, and proves beyond doubt that the commoner grades at least must have been within the popular means.

The export of papyrus was, indeed, at one time prohibited, and with important results. A king of Pergamus was gathering a library which threatened the supremacy of the collection at Alexandria. Ptolemy, king of Egypt, thought to block the ambition of his rival by shutting off the supply of papyrus. But the crisis in the book trade of Pergamus was met by the fabrication of a new product, which, under the name of parchment, that is "Pergamus paper," was destined to share with papyrus for many centuries the preferences of authors and copyists. In the end, however, the invention availed little to the claims of Pergamus as a literary center, for in the following century, the city having fallen under the sway of Rome, its library of two

hundred thousand volumes was given by Anthony to Cleopatra and was by her transferred to Alexandria. The disorganization of commerce following the Saracen occupation of Egypt in the seventh century served to enhance the use of parchment. The trade in papyrus considerably revived, however, and flourished with other arts under the domination of the Arabs. Down to the ninth century papyrus was commonly employed by the Greek scribes; in the tenth century it was still used exclusively in papal deeds, and in various localities and for special purposes its use persisted for, perhaps, a hundred years more; but by the twelfth century its manufacture had entirely ceased.

The Second of the Series

Wisdom says an Eastern writer, "hath alighted upon three things—the brain of the Franks, the hands of the Chinese, and the tongues of the Arabs." On the cunning hands of the Chinese, at any rate, first alighted the wisdom to fabricate paper, and though the brain of the Franks has contrived many improved appliances, the modern process of paper making is, in all essentials, identical with the methods devised and

still employed in the Empire of China. It is true that the Aztecs made a sort of paper from the pulp of the maguey and that the aborigines of New Zealand even were accustomed to chew up certain leaves and fibrous substances, and by spreading and drying on a smooth surface, made something which might be called paper. These, however, are merely isolated phenomena and do not enter into the great current of history. Still it is remarkable that the fundamental principle of so useful an art should have been independently reached by Aztecs, Maoris, and Chinese, and totally escaped the energetic and progressive nations bordering the Mediterranean. It would seem probable that papyrus supplied so satisfactory a material that there was no great incentive to the discovery of a substitute. The Chinese from the time of Confucius, at least, say the sixth century B. C., had been accustomed to write with a stylus on tablets made from the finely pared bark of the bamboo. The brush pencil as at present used was invented some three hundred years later, and a substitute for the bamboo tablets was at first found in a sort of closely-woven silk.

This was too expensive for general purposes and was soon superseded forever by the invention of paper. The merit of this invaluable discovery is attributed to the Marquis Tsai, a Minister of Agriculture under the Han dynasty, who, towards the end of the second century B. C., when every encouragement was given to men of letters, invented and taught in a complete manner the art of making paper from the fibres of mulberry and bamboo, and from the ends of hemp, old rags, and fishin gnets. It is, of course, possible, and perhaps even probable, that the noble Marquis has reaped the glory of the discovery of some humble person, but as to this we must always remain in ignorance and must concede to Tsai a conspicuous position among the great benefactors of the race.

The process of paper making as the Chinese have continued to practise it from the time of its discovery may be readily described, taking bamboo as the stock most commonly employed. The stalks are sorted according to age, the younger shoots making the better paper. The first step is to produce a partial decomposition of the fibres, the object

being to render the stock tender. This retting, as we should call it, is a tedious process with the Chinese. The bamboo stalks are said to be soaked in water for perhaps a hundred days before the fibres are sufficiently softened to be broken up and separated from the bark by beating. After this comes a cooking for about a week in a solution of lime; washings, boilings, and soakings in water and ashes follow until the fibres begin to decompose, when they have a final washing, and are put in mortars to be reduced to a pulp with large pestles operated by water power when available. The pulp is transferred to a vat and after being properly diluted with water is ready to be converted into paper. The workman who now comes upon the scene is provided with a rectangular sieve, usually about two feet wide, and three and one-half feet long, the meshes of which are formed of bamboo splints, oiled, and polished, and fastened with raw silk. A detachable rim, that is to say "the deckel," is laid upon the framework of the sieve and held firmly in place by the hands, the whole forming the mould. The operator dips this apparatus into the vat, the

contents of which are kept in constant agitation, and takes up a trayful of the liquid material. A few deft shakes serve to interlace the fibres and the water rapidly draining off leaves a sheet deposited on the sieve. The deckel is lifted off and the mould passed to a second workman who, in turning it up-side-down on the slanting surface of a kiln covered with gypsum, disengages the sheet, which is left for a time to set and dry. The sheets are finally placed in a pile one upon the other and subjected to heavy pressure, after which they are hung up to completely dry. Sizing is not commonly used.

Chinese paper is very light and soft, but possesses great strength and fineness. The best qualities are made in the northeastern provinces of the empire where a greater variety of stock is used, while the paper of the south is produced principally from the bamboo which gives a yellowish color and a rather coarse texture. In Peking there is said to be a quarter inhabited solely by people whose occupation is making into paper the rags which they collect through the streets of the great city, and which they reduce to pulp by beat-

ing on stone. The invention of paper contributed largely to the spread of the literary spirit for which the Chinese have always been remarkable. Paper has also assumed among them great importance in domestic economy, and a good supply of paper is not infrequently stipulated in marriage contracts.

The art of paper making was practiced for centuries within the limits of the empire before it became known even to the near neighbors of the Chinese. It was not until 610 A. D. that a knowledge of it was carried to Korea, and from thence to Japan, so complete was the isolation of the Chinese, who do not appear to have made any secret of their craft. A century later the wave of Arab Conquest touched the western borders of the Chinese dominions, and we shall next have to trace the progress and vicissitudes of our art through the vast empire of the Chalifs.

The Third of the Series

The art of writing was an unusual accomplishment among the Arabs in the time of Mohammed, and the common writing material of their neighbors, papyrus or parchment, was a rare exotic in Arabia. The Koran itself, as its various portions were from time to time revealed, was to some extent entrusted to memory, but was more generally taken down by the secretaries of the prophet on almost anything at all suitable that happened to be at hand. Zaid ibn

Thabit, who was entrusted with the task of first collecting into one whole the scattered fragments of the work some years after Mohammed's death, gathered it, we are told, from strips of cloth, palm leaves, skins, smooth stones, the shoulder blades of sheep, the bones of camels, and from the memory of men. The scarcity of a good writing surface could hardly be more emphasized; for Mohammed was rich and powerful for years before his death, and these scattered revelations were regarded as the very words of Allah himself. It must be added, however, that at this time the Arabs set no great store upon written documents among themselves, that some of their tribes possessed a considerable unwritten literature, and that many of the Moslems knew the Koran by heart, and it was only when the ranks of these "Carriers of the Koran" had been thinned in a bloody battle that the project of collecting the work in a single written volume was undertaken.

Whatever may have been the poverty, ignorance, or carelessness of the Arabs at this time as regards writing material, they were destined not long

after to become expert paper makers themselves, and to spread a knowledge of the art over the whole world of civilization.

Chinese paper became known to the Saracens about the middle of the VII century as an article obtained by way of Samarcand, the great Emporium of Central Asia, but it was a century later, when they had extended their conquests beyond the Oxus, and had for some time established themselves in Samarcand, that the process of paper making came into their possession. This important event coincides with the battle of Atlah, fought between Arabs on one side and Turks and their Chinese auxiliaries on the other in the year 751 A. D. Among the captives brought back into Samarcand by the victorious Moslems were found certain Chinese skilled in the art of paper making, and the enterprising and energetic Arabs were not long in setting them to work at their trade for the profit of their masters, a proceeding with many parallels in oriental history. The Persian speaking population of Chorasan, the province in which Samarcand lay, took up the art, and prosecuted it for a considerable time, the Arabs

themselves being too busy with their wars and other matters. To these Persians is probably due the very important step of employing linen rags as material for the fabrication of paper. The term for paper which the Arabs adopted from them was Kaghid, derived, as the Persians believe, from the word Kagh, which in their tongue signifies a rustling or crackling noise, though this etymology is regarded as superficial and the true origin of the term is most likely Chinese.

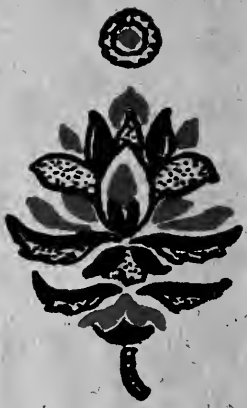
Samarcand developed its new industry rapidly, and the fame of its paper spread and continued for centuries. It was a common saying that the people of Chorasan were as skillful as though they formed a part of China, and in fact Chinese influence was long prevalent there.

It is curious to note how custom has persisted in the nomenclature of paper fabrics. The Romans, it will be remembered, styled several brands of papyrus in honor of Augustus, Livia, or Claudius, as the case might be, and in Samarcand they followed a similar politic or patriotic principle in distinguishing some of their grades with

which we are acquainted. Several designations were taken from the names of governors of Chorasan, or from great officers of the Mohammedan state. Among them we find the "Jaafar" brand which does honor to the famous vizier of Haroun al-Rashid. The "Pharao" quality was designed no doubt to compete with the Egyptian papyrus. The "Sultan" enjoyed great favor, as also the Samarcand "Silk" paper, which was, however, made from linen rags, and received its name from the soft silky touch it obtained from a light sizing of soap and the use of a glassy polishing stone. It was clearly an imitation of a Chinese article.

Samarcand, the mother city of the paper trade in Islam, monopolized the manufacture for about fifty years. The spreading of the art through the dominions of the Chalifs began with the adoption of paper for official use in the various departments of the government. The Ommeyads who held their court at Damascus had commonly employed papyrus rolls for their despatches, public documents and records. Under their successors the Abbaside Chalifs, who established their capital at Bagdad,

parchment seems to have quite generally supplanted the Egyptian fabric. It is related that during some disturbances early in this period the public offices were sacked and the records, which were all on parchment, were carried off, and, the writing having been washed off, the parchment was sold for writing material, and it is said to have been sufficient to satisfy the needs of the inhabitants for a long time. The credit of the innovation which substituted paper for the older material in the governmental offices is due to the all powerful vizier Jaafar, though it may be conjectured that he was largely influenced by the advice of his brother who had been governor of Chorasan and had probably there become acquainted with the value of the product of the Samarcand paper workers. One of the principal motives for this step was, no doubt, that, aside from the costliness of parchment, writing on this or on papyrus could easily be scratched or washed out, which could not be done on paper without leaving easily discernible traces.



The Fourth of the Series

With the official adoption of paper in the various departments of the government and the establishment at Bagdad of a paper mill under government control, which occurred about 795 A. D., the fortunes of the fabric may be regarded as permanently settled, and the way opened for its rapid spread. It was not long before paper works were in operation in all parts of the Moslem world. In Bagdad the industry flourished well into the fourteenth century, the product being distinguished for its admirable quality and the sheets being

made up of unusual size for the special purposes of the state. In Arabia itself factories were soon in operation on the southwest coast, though the account of a paper mill at Mecca which formerly ran through books on this subject has no secure basis. In the tenth century paper making was prosecuted in Yemen along with the thriving kindred industry of bookbinding.

Paper making does not seem to have taken root very early in Egypt, notwithstanding the favorable circumstances of a large linen industry, and an inexhaustible supply of rags from the mummy cloths of ancient tombs, rifled by Bedouins either for their own clothing or for immediate sale to paper workers. Probably the papyrus factories made a hard fight against the intruder on their own grounds. Nevertheless the newer and better article eventually won, and by the tenth century paper making was firmly established in the valley of the Nile. Some very beautiful and delicate specimens of Egyptian paper are still to be seen in the collection of the Archduke Rainer at Vienna. Cairo was the center of the Egyptian paper trade and one of its thoroughfares bore the name of "old

paper makers street." A specialty of the Egyptians was the so-called "Bird paper," made extremely light but firm for use of the "Pigeon post" which was operated systematically by the government, and by means of which the capital was kept constantly and promptly advised of all matters even from the uttermost parts of the realm.

Tiberias in Palestine and several places in Syria prosecuted the art of paper making. In all this region, however, Damascus was by far the most conspicuous in this respect. Under the name of Charta Damascena its paper became famous through Europe, and in the East, as Syrian paper, seriously rivalled the output of the Bagdad mills.

At Fez in North Africa the trade must have reached great dimensions, as it is stated that four hundred mill stones were there busy in making paper.

The industry in Spain was located at Xativa, a beautiful, fortified city not far from Valencia. The excellence of its paper was proverbial and it supplied the demands of all Andalusia. The art of linen making had flourished here even from the time of Pliny, and this fact probably attracted the paper industry.

At the other extremity of the Arab dominion the manufacture of paper was carried on among the Hindoos, whose earlier writing surface had been supplied by the birch bark and the palm leaf.

The materials used by the Arab paper makers were linen rags and, to some extent, hemp and ravelled cordage. Their methods were practically those of the Chinese, though they have the credit of employing the mill stone run by water to reduce their stuffs to pulp.

In respect to colors, some interesting details may be noted. The ground color of the Arab paper makers was white, as with us, and they had early learned the art of producing a pure white, so that "white as paper" was a common expression among them. Their blue tints were obtained from indigo and cobalt. In a large part of the Mohammedan world blue was the mourning color, and sentences of death were drawn up on blue paper. It was an unhappy selection of color, then, when the Byzantine Emperor sent to the Chalif of Cordova a magnificent Epistle in letters of gold on a blue ground. In Persia, on the other hand, medicines were wrapped in blue

paper as a good omen. Notwithstanding the fact that Mohammed himself had stigmatized red as "an adornment of Satan," it enjoyed great favor among the faithful as a fortunate and festive color in all its shades. It was also regarded as the color of humanity and was worn by the oppressed and needy to attract public attention, and it was related that a deaf Indian King had ordained this custom that he might readily recognize cases demanding attention. In Persia these peculiar red garments were made of paper and were worn also by the plaintiff in court, so that "paper shirt" became a slang term for law suit. Yellow was next to red the favorite color of the Oriental paper makers, and even before the introduction of paper the Persians had been accustomed to dye parchment and papyrus a safron hue. An astonishing variety of yellow shades is exhibited in the manuscript collections. Yellow being the color of wealth and magnificence, paper colored with safron enjoyed specially high consideration. Variegated paper served for all kinds of ornamentation.

The sizing employed by the Arabs

has been shown by the microscope to have been a paste of wheat starch.

Notwithstanding the great debt which European civilization owes to the Arab paper maker, but one technical term of this trade of Arabic origin has been bequeathed to us. Our word "ream" is derived through the old French "resme," from the Arabic "rizma," which means simply a bundle, or a package; but this word is one of the many signposts, as they have been called, which indicate the route from East to West which has been travelled by so many arts and sciences.

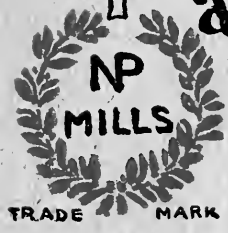
The PAPERS

used in the making of this book

for the cover

RHINOS-SULTAN

for the pages

ITALIA

Rich in color and texture and durable